

CLAIMS

What we claim is:

1. A method of producing an antimicrobial hard surface substrate comprising the steps of
 - a) providing a hard surface substrate;
 - b) providing a sol-gel precursor formulation comprising a host precursor component and at least one metal-containing antimicrobial agent;
 - c) compounding said sol-gel film precursor formulation to produce an adhesive sol-gel coating composition;
 - d) applying said sol-gel coating composition to at least a portion of said hard surface substrate; and
 - e) exposing said sol-gel coated hard surface substrate to a temperature of at most about 800°C to form a finished sol-gel film-coated hard surface substrate, wherein said finished substrate exhibits a log kill rate for *Klebsiella pneumoniae* of at least 0.5 as measured under a modified plate contact method.
2. The method of Claim 1 wherein the log kill rate is at least 1.0.
3. The method of Claim 2 wherein the log kill rate is at least 2.0.
4. The method of Claim 3 wherein the log kill rate is at least 3.0.
5. The method of Claim 4 wherein the log kill rate is at least 3.5.

6. The method of Claim 1 wherein said metal-containing antimicrobial agent is selected from the group consisting of metal oxides, metal-containing ion-exchange compounds, metal-containing zeolites, metal-containing glasses, metal sulfadiazine, and any mixtures thereof.

7. The method of Claim 6 wherein said metal-containing antimicrobial agent is selected from the group consisting of silver oxide, silver-containing ion-exchange compounds, silver-containing zeolites, silver-containing glasses, silver sulfadiazine, and any mixtures thereof.

8. The method of Claim 6 wherein said host precursor is selected from the group consisting of TMOS, TEOS, aluminum acetylacetonate, titanium acetylacetonate, zirconium acetylacetonate, and any mixtures thereof.

9. The method of Claim 2 wherein said metal-containing antimicrobial agent is selected from the group consisting of metal oxides, metal-containing ion-exchange compounds, metal-containing zeolites, metal-containing glasses, metal sulfadiazine, and any mixtures thereof.

10. The method of Claim 3 wherein said metal-containing antimicrobial agent is selected from the group consisting of metal oxides, metal-containing ion-exchange compounds, metal-containing zeolites, metal-containing glasses, metal sulfadiazine, and

any mixtures thereof.

11. The method of Claim 4 wherein said metal-containing antimicrobial agent is selected from the group consisting of metal oxides, metal-containing ion-exchange compounds, metal-containing zeolites, metal -containing glasses, metal sulfadiazine, and any mixtures thereof.

12. The method of Claim 5 wherein said metal-containing antimicrobial agent is selected from the group consisting of metal oxides, metal-containing ion-exchange compounds, metal-containing zeolites, metal-containing glasses, metal sulfadiazine, and any mixtures thereof.

13. The method of Claim 2 wherein said host precursor is selected from the group consisting of TMOS, TEOS, aluminum acetylacetonate, titanium acetylacetonate, zirconium acetylacetonate, and any mixtures thereof.

14. The method of Claim 3 wherein said host precursor is selected from the group consisting of TMOS, TEOS, aluminum acetylacetonate, titanium acetylacetonate, zirconium acetylacetonate, and any mixtures thereof.

15. The method of Claim 4 wherein said host precursor is selected from the group consisting of TMOS, TEOS, aluminum acetylacetonate, titanium acetylacetonate, zirconium acetylacetonate, and any mixtures thereof.

- | Parameter | Value |
|----------------------------------|------------------------|
| Initial temperature | 25 °C |
| Final temperature | 100 °C |
| Heating rate | 10 °C/min |
| Modulation amplitude | 0.5 °C |
| Modulation period | 32 s |
| Modulation frequency | 0.031 Hz |
| Modulation phase | 0° |
| Modulation type | Temperature |
| Modulation direction | Up |
| Modulation speed | 10 °C/min |
| Modulation acceleration | 10 °C/min ² |
| Modulation deceleration | 10 °C/min ² |
| Modulation dwell | 10 s |
| Modulation dwell time | 10 s |
| Modulation dwell temperature | 25 °C |
| Modulation dwell time at 25 °C | 10 s |
| Modulation dwell time at 100 °C | 10 s |
| Modulation dwell time at 50 °C | 10 s |
| Modulation dwell time at 75 °C | 10 s |
| Modulation dwell time at 125 °C | 10 s |
| Modulation dwell time at 150 °C | 10 s |
| Modulation dwell time at 175 °C | 10 s |
| Modulation dwell time at 200 °C | 10 s |
| Modulation dwell time at 225 °C | 10 s |
| Modulation dwell time at 250 °C | 10 s |
| Modulation dwell time at 275 °C | 10 s |
| Modulation dwell time at 300 °C | 10 s |
| Modulation dwell time at 325 °C | 10 s |
| Modulation dwell time at 350 °C | 10 s |
| Modulation dwell time at 375 °C | 10 s |
| Modulation dwell time at 400 °C | 10 s |
| Modulation dwell time at 425 °C | 10 s |
| Modulation dwell time at 450 °C | 10 s |
| Modulation dwell time at 475 °C | 10 s |
| Modulation dwell time at 500 °C | 10 s |
| Modulation dwell time at 525 °C | 10 s |
| Modulation dwell time at 550 °C | 10 s |
| Modulation dwell time at 575 °C | 10 s |
| Modulation dwell time at 600 °C | 10 s |
| Modulation dwell time at 625 °C | 10 s |
| Modulation dwell time at 650 °C | 10 s |
| Modulation dwell time at 675 °C | 10 s |
| Modulation dwell time at 700 °C | 10 s |
| Modulation dwell time at 725 °C | 10 s |
| Modulation dwell time at 750 °C | 10 s |
| Modulation dwell time at 775 °C | 10 s |
| Modulation dwell time at 800 °C | 10 s |
| Modulation dwell time at 825 °C | 10 s |
| Modulation dwell time at 850 °C | 10 s |
| Modulation dwell time at 875 °C | 10 s |
| Modulation dwell time at 900 °C | 10 s |
| Modulation dwell time at 925 °C | 10 s |
| Modulation dwell time at 950 °C | 10 s |
| Modulation dwell time at 975 °C | 10 s |
| Modulation dwell time at 1000 °C | 10 s |